

## SECTION 11616

### GLOVEBOX FEEDTHROUGHS, HERMETICALLY-SEALED

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#### **LANL MASTER CONSTRUCTION SPECIFICATION**

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the LEM Mechanical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Information within “stars” is provided as guidance to the author responsible for revising the specification. Delete information within “stars” during editing.

This specification serves as a template. The specification was prepared by an organization operating under a quality assurance program that meets the requirements of 10 CFR 830 (suitable for ML-1 through ML-4 projects). Implementation of this specification requires modification to the specification to meet project-specific requirements. Responsibility for application of this specification to meet project-specific requirements lies with the organization modifying or implementing the specification. The organization modifying the specification shall apply a graded approach to quality assurance based on the management level designation of the project. When this specification is used with nuclear facilities subject to 10 CFR 830, modification to this specification must be performed by an individual or organization operating under a quality assurance program that meets the requirements of that CFR.

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This specification is a general specification covering a range of bulkhead feedthrough hermetically-sealed wire and cable assemblies as well as military-style circular hermetically-sealed electrical connectors for glovebox applications. It is intended to be used for procurements of bulkhead electrical feedthroughs with extremely low leakage rates.

The technical requirements of this specification are applicable to feedthroughs with relatively low pressure differentials across them—on the order of +/- 7 in. maximum water column pressure with glovebox applications. However, because of the hazardous nature of some substances contained in gloveboxes, a very low helium leakage rate is required of these feedthroughs.

This master specification requires project specific editing to add special requirements to the general electrical feedthrough requirements listed. It requires deletion of requirements that are not pertinent to the specific design being addressed, and addition of requirements that may not be directly addressed in this master specification. To seek a variance from applicable requirements, contact the Mechanical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements. Employ design verification personnel to review and approve the finished specification after editing, verifying that applicable sections of the specification have been maintained. Ultimate responsibility for defining applicable requirements associated with procuring the correct glovebox hermetic feedthroughs lies with the author of the project-specific specification.

**TA-55 NOTE:** Currently, only Douglas Electrical Components custom-designed sealed wiring harnesses and connectors are authorized for TA-55 use. Refer to Attachment 1 of this Section. Although O-ring type feedthroughs are not the TA-55 standard, allowances/exceptions may be approved by facility management with sufficient technical justification, procurement documentation, and installation procedure documentation. Management approval is required before any use.

Feedthroughs, which are currently not approved for use in TA-55, may still be acceptable in other LANL facilities. Refer to facility-specific specifications and regulations.

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## PART 1 GENERAL

### 1.1 SECTION INCLUDES

- A. Sealed wire & cable assemblies with wiring potted into threaded pipe nipples using epoxy or other suitable potting compound to form a leakproof seal around the wiring or cabling. Wiring extends a specified distance from either side of the pipe nipple to allow for connections to be made. The unit is intended to pass electrical signals and power through a bulkhead wall by being screwed into a suitably-sized pipe coupling which is welded into a service panel or the bulkhead wall.

These units will be referred to as “sealed wiring harness(es)”

- B. Military-style circular connectors with pipe threads sealed to a bulkhead pipe coupling and military-style circular connectors sealed to a flat polished bulkhead with an O-ring and clamping nut. Both connector types are intended to accept a mating cable connector on each end. These units also provide a leakproof seal to pass electrical signals or power through a bulkhead wall, although the O-ring type is vulnerable to O-ring damage and deterioration.

These units will be referred to as “sealed connector(s)”

- C. Alternate or substitute products to the glovebox hermetically sealed electrical feedthroughs described in this Section are not allowed without specific approval by LANL.

### 1.2 RELATED SECTIONS

- A. Section 11620, Glovebox Installation

### 1.3 REFERENCES

- A. Codes, specifications, and standards referred to by number or title form a part of this specification to the extent required by the following references. Use codes, specifications, and standards referenced below of the latest revision at the time of award of contract, unless otherwise stated below.
  - 1. 10 CFR 830.122, Nuclear Safety Management, Quality Assurance Criteria, <http://www.access.gpo.gov/nara/cfr/cfr-table-search.html#page1>
  - 2. MIL-STD-1344A, Test Methods for Electrical Connectors, <http://assist2.daps.dla.mil/quicksearch/>
  - 3. MIL-STD-202, Test Method for Electronics and Electrical Component Parts
  - 4. MIL-C-26482, General Specification for Connectors, Electrical (Circular, miniature, Quick Disconnect, Environment Resisting), Receptacles and Plugs.

5. MIL-STD-1285, Marking of Electrical and Electronic Parts
6. MIL-C-55330, Connectors, Electrical and Fiber Optic, Packaging of
7. SAE-AS90376 or National Aerospace Standards Committee (NA/NAS) NAS831 or NAS837 for Cap, Dust, Plastic, Electric Connector (these replace MS90376E).
8. Underwriter's Laboratories (UL) Standards

#### 1.4 SYSTEM DESCRIPTION

- A. Hermetically sealed electrical bulkhead feedthrough devices are used to feed electrical power and instrumentation signals through a bulkhead wall of a glovebox, or a service panel. They provide a leak-tight seal for the wiring pass-through that preserves glovebox integrity and maintains isolation of the potentially hazardous materials that a glovebox may contain.
- B. Design Requirements, Performance Requirements
  1. General
    - a. Design and fabricate hermetically sealed bulkhead electrical feedthroughs in accordance with this Section, specifications listed in Paragraph 1.2, and applicable regulations listed in Paragraph 1.3.
    - b. Bring any conflicts between the above documents to LANL's attention for resolution.
  2. Electrical
    - a. Provide adequate wiring insulation and potting compound with adequate electrical insulating properties. No voltage leakage, breakdown, or flashover is allowed between conductors or between conductors and the outer body of the feedthrough at operating conditions.
    - b. Set operating rated voltage no higher than 25% of the minimum insulation breakdown voltage to allow for switching, voltage surges, and similar phenomena.
    - c. Rated operating voltage

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Delete statements below which do not apply, if ordering only one type of feedthrough.

Include any special requirements or explanations. If multiple working voltages are required, so state and list by feedthrough groups.

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- The rated operating voltage of sealed connectors is [insert voltage requirement, type], with a [insert amperage requirement] current rating.
- The rated operating voltage of sealed wiring harnesses is [insert voltage requirement, type], with [insert amperage requirement] current rating.

d. Impedance

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Delete unneeded paragraphs below, or entire impedance section if feedthroughs are for low-frequency or non-critical applications. Impedance of the feedthrough is mainly important for high frequency signal wires. Wire/connector shielding may be required.

For some high frequency signals, "impedance matching" of feedthroughs to certain devices may be required to achieve proper SWR's (standing wave ratio).

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- The impedance range of sealed connectors is [insert requirement].
- The impedance range of sealed wiring harnesses is [insert requirement].
- Measured SWR (standing wave ratio) for these feedthroughs is less than [insert requirement] over the frequency range of [insert frequency range].

- e. The contact resistance for sealed connectors is: (1) less than [insert requirement] for normal contact resistance (2) less than [insert requirement] for low-signal level contact resistance, as defined in MIL-STD-1344A.

3. Mechanical

Sealed connectors and sealed wiring harnesses are to be manufactured to be dimensionally accurate, uniform in quality, and free from defects that would affect serviceability, reliability, and appearance.

a. Leakage

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Specification author is to insert his requirement if greater or lesser leak tightness is required for the specific application. A  $1 \times 10^{-6}$  cc/sec leak is equivalent to about 0.053 in<sup>3</sup>/day, or about 1.6 cubic inches per month. A  $5 \times 10^{-8}$  cc/sec leak rate is equivalent to about one cubic inch per year.

Also insert project-specific requirements for pressure and vacuum rating.

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The maximum allowable helium leakage through and around a sealed connector with O-ring sealing is [ $1 \times 10^{-6}$  cc/sec] when tested at [14.7] psig.

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TA-55 NOTE: Currently, only Douglas Electrical Components specially-designed sealed wiring harnesses and connectors are authorized for TA-55 use. Refer to Attachment 1 of this Section.

Although O-ring type feedthroughs are not the TA-55 standard, allowances/exceptions may be approved by facility management with sufficient technical justification, procurement documentation, and installation procedure documentation. Management approval is required before any use.

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The maximum allowable helium leakage through and around a sealed wiring harness is [ $5 \times 10^{-8}$  cc/sec] when tested at [14.7 psig].

- b. Pressure rating.

The rated operating pressure for both sealed connectors and sealed wiring harnesses is [100 psig].

c. Vacuum rating.

The rated operating vacuum for both sealed connectors and sealed wiring harnesses is [1 x 10<sup>-8</sup> mm Hg].

d. Temperature rating.

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The temperature limits shown in “specify” brackets below are the widest known that are currently offered by industry. Specifier may be able to obtain more economical feedthroughs if a smaller temperature range is adequate.

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The rated operating temperature range for both sealed connectors and sealed wiring harnesses is [-40 °F to +250 °F].

e. Sealed connectors are to show no mechanical or electrical defects detrimental to the operation of the connector after [500 cycles] of mating and unmating, in accordance with the testing methods in MIL-STD-1344A.

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Connectors specified in the following paragraphs would be a “normal” or “standard” configuration, and the type most commonly used. Specification author is to modify these paragraphs for any special requirements or special configurations he may need.

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Change statement for special clocking.

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f. Sealed connectors are to be configured with an “N” insert position (normal).

g. Mating Connectors

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Change statement if mating connectors are not required.

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Supply compatible mating male and female contact wire cable plugs for the ends of each sealed connector in the shipment. [Specify type of end terminations required for sealed wiring harnesses]

Supply male and female contact wire cable plugs for the wiring on each end of each sealed wiring harness in the shipment.

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Specify other contact terminations if required.

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Supply standard solder pot-type contact terminations for connector plugs, where required.

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Specify shielded, if required for high frequency applications.

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- h. Do not supply shielded contacts with sealed connectors, or shielded wiring with sealed wiring harnesses.
- i. Sealed connectors are to have pins on one side and sockets on the other side. Do not furnish connectors with “pin-pin” or “socket-socket” configuration.

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Paragraph 1.4.A.4 addresses the requirements of high radiation environments. Alter the section as required to meet project-specific conditions.

Highly radiation resistant wiring insulation that may be considered by the specification author include polyimides (Kapton) and ethylene tetrafluoroethylene copolymer (Tefzel). Other less-expensive materials may also provide the necessary resistance at lower radiation levels.

Do not use feedthroughs with O-ring seals in high radiation areas.

TA-55 NOTE: Currently, only Douglas Electrical Components custom-designed sealed wiring harnesses and connectors are authorized for TA-55 use. Refer to Attachment 1 of this Section.

Although O-ring type feedthroughs are not the TA-55 standard, allowances/exceptions may be approved by facility management with sufficient technical justification, procurement documentation, and installation procedure documentation. Management approval is required before any use.

If radiation is not a problem for the project-specific application, delete the section below.

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#### 4. Radiation Resistance

- a. Insulate wiring protruding from sealed wiring harnesses that is on the “interior” side (threaded side) of the feedthrough with radiation-resistant materials. Design the wiring insulation to have a service life of [insert requirement] years while exposed to a radiation level of [insert requirement] Rads/hr for a total of [insert total] Rads exposure without failure. Failure is defined as embrittlement and cracking to the point where the electrical insulation of the wire is compromised.
- b. Use [Kapton, Tefzel, nylon, polyurethane, etc.] for wiring insulation.
- c. Use radiation-resistant sealant material in potting the wiring/pins in a sealed connector. Use a potting material that has a service life equal to or better than that described in paragraph 1.4.A.4.a above (for sealed wiring harness insulation life). Failure is defined as exceeding a helium leakage requirement of [1 x 10<sup>-6</sup> cc/sec] across connector unit, including O-ring seal or NPT threads, loss of electrical insulating ability below a dielectric strength of [95%] of the unit’s original value, or any visible cracking of the sealant.

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Edit submittal requirements below to meet project-specific requirements.

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#### 1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01330, Submittal Procedures. Refer to LANL Contract Number on correspondence.

B. Product Data

1. Submit catalog data for each type of hermetically-sealed feedthrough device, including data verifying that the device meets the Design and Performance requirements of Section 1.4 and is constructed of materials meeting requirements of Section 2.2 B.

C. Quality Assurance/Quality Control

1. Design Data

- a. Provide data showing design capabilities and operational limits of feedthrough usage including, but not limited to: (1) Maximum operating voltage, (2) Maximum current permitted, (3) Impedance Characteristics (signal feedthroughs only), (4) Operating temperature limits, (5) Leakage rate, (6) Operating pressure limit, (7) Vacuum rating.

2. Material Certifications

- a. Provide material certifications, including mill test reports where required.
- b. Provide Certified Material Test Reports (CMTR's) for the stainless steel used in fabrication of sealed connectors and sealed wiring harnesses. Certificates of Conformance may be substituted for CMTR's with LANL approval.
- c. Provide documentation for potting material, contact material & plating, wiring and insulation, and other feedthrough materials of construction as necessary to certify that the materials meet the design requirements necessary to support required connector performance.

3. Test Reports

- a. Provide documentation verifying that feedthroughs meet the design requirements.
- b. Provide test reports/data sheets documentation as required in the contract documents, MIL-STD-1344A, and MIL-STD-202.

4. Manufacturer's Instructions

- a. Provide documentation with Manufacturer's recommendations on proper installation and connection of feedthroughs to obtain optimum performance and meet design specifications.

5. Qualification Statements

List qualifications and experience of Manufacturer and involved personnel to produce these specialized hermetically-sealed electrical feedthrough devices.

1.6 QUALITY ASSURANCE

Control the design, materials, preparation, fabrication, inspection, testing, cleaning, packaging, and shipping of sealed connectors and sealed wiring harnesses to insure the production of an acceptable finished product. Maintain a QA program in accordance with the basic requirements of 10 CFR 830.122.

A. Qualifications

1. Submit an uncontrolled copy of the Manufacturer's QA manual to LANL for approval.

B. Material Control Procedure

1. Provide a copy of the Manufacturer's material control procedure used in the manufacture of sealed electrical feedthroughs. Describe control methods and traceability documentation used to handle and monitor the use of controlled materials.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect, store, pack, and ship feedthroughs to prevent damage.
- B. Protect from corrosion and contamination.
- C. Protect installation threads and wiring/connector ends from mechanical damage.
- D. Prepare for shipping in accordance with MIL-C-55330.
- E. Install a plastic cap, in accordance with SAE-AS90376, NAS831, or NAS837, on each end of sealed bulkhead feedthrough connectors before shipping.

1.8 NONCONFORMANCES

- A. Submit a Supplier Deviation Disposition Request (SDDR) to LANL for any proposed technical changes, exceptions, and/or deviations to this specification or contract documents. Submit changes that affect cost or schedule in accordance with contract document provisions.
- B. Notify LANL of any conflicts among specifications, manufacturer's recommended processes/instructions, and contract documents. Provide notification of a conflict immediately.

1.9 PROJECT/SITE CONDITIONS

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Add section describing high radiation environment conditions if applicable.

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- A. Feedthrough use location is at 7,500 feet elevation above sea level. Provide any service de-rating factor that applies due to use at high altitude to LANL. This requirement is in addition to the standard design requirements for temperature and pressure service.

PART 2 PRODUCTS

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An approved vendors list will be established for hermetically-sealed electrical feedthrough vendors in accordance with the appropriate Quality Assurance Program Plan. Specification authors are to select vendors from the approved vendors list.

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2.1 MANUFACTURERS

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Currently, only the following manufacturer's products are approved for use in TA-55 (refer to Attachment 1 of this Section for further details.

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Douglas Electrical Components  
(formerly Douglas Engineering)  
14 Beach Street  
Rockaway, NJ 07866  
973-627-8230  
[info@douglaselectrical.com](mailto:info@douglaselectrical.com)

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Other manufacturer's products may be suitable for use in other approved applications at LANL facilities. Refer to project-specific requirements. Below are listed examples of other electrical feedthrough manufacturers.

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Pave Technology Co.  
2751 Thunderhawk Court  
Dayton, Ohio 45414-3445  
+1.937.890.1100 x6  
+1.937.890.5165 fax  
[sales@pavetechnologyco.com](mailto:sales@pavetechnologyco.com)

ITT Industries  
4 West Red Oak Lane  
White Plains, NY 10604  
Phone: 914-641-2000  
Fax: 914-696-2950

## 2.2 MANUFACTURED UNITS REQUIREMENTS--SEALED WIRING HARNESSSES AND SEALED CONNECTORS

### A. Fabrication

1. Use methods, materials, and tolerances in accordance with referenced specifications and standards.
2. For sealed wiring harnesses, provide wiring length extension of [insert length requirement] on threaded side of feedthrough, and [insert length requirement] on the unthreaded side of the feedthrough.

### B. Materials

1. Hermetically sealed connector and wiring harness components: High-strength, vacuum-degassed, molded epoxy dielectric or other suitable material, so that any significant gas leakage through electrical connections is eliminated.
2. Housings and any associated hardware: 300 series stainless steel passivated in accordance with AMS-QQ-P-35.

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O-ring sealed feedthroughs are not currently approved for use in TA-55, but may be used in other approved applications at LANL. Refer to attachment 1 for more details.

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3. Feedthroughs O-ring seal material: [insert O-ring material required for project conditions].
4. Sealed connectors, connector pin and socket material: [copper with gold plating]
5. Sealed wiring harnesses insulation: [insert proper wiring insulation material to fit project conditions].

## PART 3 EXECUTION

### 3.1 TOLERANCES

Conform dimensional tolerances for manufacturing with MIL-C-26482, and referenced specifications. Otherwise, follow generally accepted industrial standards.

### 3.2 ACCEPTANCE TESTS

- A. Test completed sealed connector and sealed wiring harness assemblies in accordance with MIL-STD-1344A, MIL-STD-202, and UL Standards. Verify electrical and mechanical design requirements and leakage rates. The Manufacturer is responsible for the performance of all specified inspection requirements, unless otherwise stated in the contract or purchase order.

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The test listing below is not necessarily comprehensive, but identifies some common tests used to qualify electrical connectors. Add additional project-specific requirements, or delete unnecessary restrictions to reduce cost of non-critical feedthroughs.

Add mechanical and environmental testing as required. Refer to test listings in MIL-STD-1344A and MIL-STD-202.

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#### 1. High Potential Test

Test sealed connectors and sealed wiring harnesses for evidence of breakdown or flashover between conductors, or between conductors and outer body in accordance with MIL-STD-1344A, Test Methods for Electrical Connectors, MIL-STD-202, Test Method for Electronics and Electrical Component Parts, and UL Standards, based upon the required rated operating voltage of the feedthrough.

#### 2. Insulation Resistance

Test sealed connectors or sealed wiring harnesses, for insulation resistance between contacts or contact and outer body in accordance with MIL-STD-1344A, Test Methods for Electrical Connectors, MIL-STD-202, Test Method for Electronics and Electrical Component Parts, and UL Standards, based upon the required rated operating voltage of the feedthrough.

#### 3. Standing Wave Ratio (SWR)

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Usually required only for higher frequency signal applications.

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Test feedthrough SWR in accordance with the requirements of MIL-STD-1344A.

4. Contact Resistance

Test sealed connector contact resistance in accordance with MIL-STD-1344A.

- B. Install and maintain test and measuring equipment of sufficient accuracy, quality, and quantity to permit the required connector testing and inspection at Manufacturer's facilities.
- C. LANL reserves the right to repeat any of the inspections noted above as verification that the sealed feedthroughs conform to prescribed requirements.

3.3 LABELING AND IDENTIFICATION

- A. Identify and mark connectors in accordance with MIL-STD-1285.

3.4 INSTALLATION

- A. Install Douglas Electrical Components approved sealed wiring harnesses and sealed connectors with NPT threads into glovebox service panel NPT pipe couplings using teflon tape and a suitable pipe thread sealant (example: "TruBlu") applied to feedthrough threads. Torque feedthrough "snug tight".
- B. Install O-ring sealed feedthroughs, where approved, through a suitably sized hole in a glovebox service panel or through a flat area of a glovebox wall. Polish the O-ring sealing surface must to a minimum 32  $\mu$ -inch finish with circular lay.
- C. Helium leak check completed service panel and glovebox in accordance with the requirements of Section 11620 and Section 11610.

END OF SECTION

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Do not delete the following reference information:

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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 0, dated December 5, 2002.

Section 11616 -- Attachment 1  
TA-55 SPECIAL REQUIREMENTS  
FOR HERMETICALLY SEALED GLOVEBOX FEEDTHROUGHS

## SECTION 11616 -- ATTACHMENT 1

### SPECIAL TA-55 DESIGN REQUIREMENTS FOR ELECTRICAL FEEDTHROUGHS

Because of past performance issues with glovebox electrical feedthroughs, only certain types of feedthroughs are currently approved for use in TA-55. The Douglas Electrical Components custom designed sealed wiring harnesses and connectors, as listed below, are authorized for TA-55 use.

Although O-ring type feedthroughs are not the TA-55 standard, allowances/Exceptions may be approved by facility management with sufficient technical justification, procurement documentation, and installation procedure documentation. Management approval is required before any use.

TA-55 Power Wiring Feedthroughs: The chart below lists specific sealed wiring harness feedthroughs of the NPT nipple type which have been jointly developed by LANL and Douglas Electrical Components (formerly Douglas Engineering) of Rockaway, NJ. These feedthroughs are for power wiring use in TA-55.

DE p/n	DE Quote #	SS Housing	Wires	Lengths	Color	Rating
42462	13246-1	½" nipple	3 #12awg	1' x 1'	Bl / Wh / Grn	120v, 20a
42463	13246-2	½" nipple	3 #10awg	1' x 1'	Bl / Wh / Grn	120v, 30a
42464	13246-3	½" nipple	4 #12awg	1' x 1'	Bl / Red / Wh / Grn	208v, 20a
42465	13246-4	½" nipple	4 #10awg	1' x 1'	Bl / Red / Wh / Grn	208v, 30a
42466	13246-5	1" nipple	1 #10awg 3 #8awg	1' x 1'	Grn Bl / Red / Wh	208v, 50a
42467	13246-6	¾" nipple	5 #12awg	1' x 1'	Bl / Red / Grn / Blu / Wh	208v, 20a, 3ph
42468	13246-7	¾" nipple	5 #10awg	1' x 1'	Bl / Red / Grn / Blu / Wh	208v, 30a, 3ph
42469	13246-8	1" nipple	1 #10awg 4 #8awg	1' x 1'	Grn Bl / Red / Blu / Wh	208v, 50a, 3ph
42679	13246-9	¾" nipple	5 #12awg	1' x 1'	Brn / Org / Yel / Wh / Grn	480v, 20a, 3ph
42680	13246-10	¾" nipple	5 #10awg	1' x 1'	Brn / Org / Yel / Wh / Grn	480v, 30a, 3ph
42681	13246-11	1" nipple	1 #10awg 4 #8awg	1' x 1'	Grn Brn / Org / Yel / Wh	480v, 50a, 3ph

TA-55 Signal Wiring Feedthroughs: Listed on the attached drawing 55Y-002446 (see Attachment 1-3) are TA-55 sealed connector feedthroughs of the NPT nipple type which are suitable for signal wiring applications. These feedthroughs were also jointly developed by LANL and Douglas Electrical Components.

TA-55 Fiber Optics Feedthroughs: Fiber optics feedthroughs are still under development by LANL and there are issues to be resolved. Fiber optic glovebox feedthroughs will be addressed in a later revision of this specification.

TA-55 Coaxial cable Feedthroughs: Coaxial cable feedthroughs are still under development by LANL and there are issues to be resolved. Coaxial cable glovebox feedthroughs will be addressed in a later revision of this specification.

